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THE CORN ROOT-APHIS AND METHODS OF CONTROLLING IT

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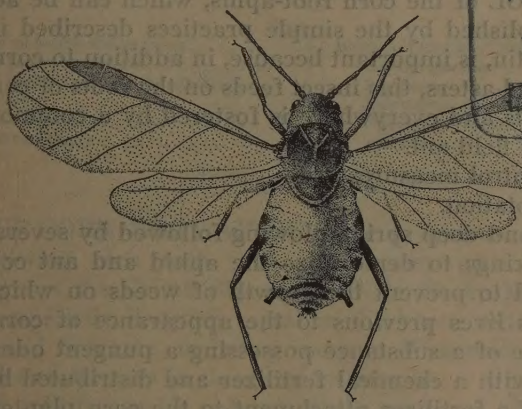

Winged female of corn root-aphis (form that produces living young). Greatly enlarged

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L. O. HOWARD, Chief

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CONTROL of the corn root-aphis, which can be accomplished by the simple practices described in this bulletin, is important because, in addition to corn, cotton, and asters, this insect feeds on the roots of certain weeds and everywhere is fostered by a common species of field ant.

The control measures are—

Crop rotation.

Early and deep spring plowing followed by several deep diskings to demoralize the aphid and ant colonies and to prevent the growth of weeds on which the aphis lives previous to the appearance of corn.

The use of a substance possessing a pungent odor, applied with a chemical fertilizer and distributed by means of a fertilizer attachment to the corn planter, to repel the ants and prevent them from placing aphids on the roots of the corn or other cultivated crop.

The use of barnyard manure or other fertilizer as an aid in producing stronger plants. Though this does not reduce the number of aphids, directly or indirectly, it enables the plants to withstand injury better. It is recommended only as supplementary to the practices already mentioned.

THE CORN ROOT-APHIS[1] AND METHODS OF CONTROLLING IT.

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THE CORN ROOT-APHIS commits serious depredations on growing corn each year. It is very generally distributed throughout the United States east of the Rocky Mountains, but it is an especially destructive pest in the "corn belt" from Ohio to Iowa and Nebraska, including southern Wisconsin. Its abundance and destructiveness in these regions may be traced with reasonable certainty to the practice of growing two or more successive crops of corn on the same land, and this fact has a direct bearing on the practical control of the insect. It is injurious also to cotton in the South Atlantic States and to cultivated asters almost everywhere.

FIG. 1.—The corn root-aphis: Wingless female of the form that produces living young. Greatly enlarged. (Redrawn from Forbes.)

THE CORN ROOT-APHIS AND ITS INJURY.

The corn root-aphis (fig. 1) is a small, soft-bodied insect not larger than a pinhead, almost spherical when full grown, and of a bluish-green color, more or less dusted with a fine whitish powder which makes it appear grayish-green. The aphids cluster on the corn roots (fig. 2) and suck the plant juices, this continual drain acting on the plant in somewhat the same way as a drought. The greatest and most noticeable injury occurs in spring before the plants have made any considerable growth. Infested plants are dwarfed and

[1] *Aphis maidiradicis* Forbes.

the leaves become brown or otherwise discolored. Although even the heavily infested plants seldom are killed outright, usually they do not make any appreciable growth. Infestations later in the season are less noticeable and indeed seldom are recognized because the

FIG. 2.—Young corn plant showing corn root-aphids feeding on the roots.

plants as a rule are not injured outwardly. The extent of apparent damage varies with the season; conditions favoring the growth of corn sometimes enable the plants to make a fair development in spite of the insect, and an unfavorable season makes the injury unusually conspicuous.

HOW TO RECOGNIZE ROOT-APHIS INJURY.

Injury by the corn root-aphis may be distinguished from that caused by other insects if the following points are observed: (1) Root

aphids usually attack corn that is grown on cornland, although occasionally other ground may develop heavy infestations if it has harbored certain weeds and likewise the aphids. (2) Injury, resulting in a stunting of the plants and yellowing of the leaves, usually occurs in early summer, when the plants are from 6 to 18 inches high. (3) Ant hills and the common brown cornfield ants are to be found at or near corn plants attacked by root aphids. (4) Plants infested with root-aphids have a complete root system, but when uprooted the bluish-green aphids will be found thickly clustered on the roots and on the underside of the crown at the base of the roots.

SEASONAL HISTORY AND HABITS.

There are four distinct forms of the corn root-aphis. The true sexes—that is to say, the males and the egg-laying females (fig. 3)—occur only in the fall. These females lay the pale yellowish-green eggs which later turn to jet black. Ants take the aphid eggs to their nests and care for them during the winter months. In spring, and continuing throughout the summer, only winged and wingless females are to be found, and these give birth to living young. (See title-page illustration and fig. 1.)

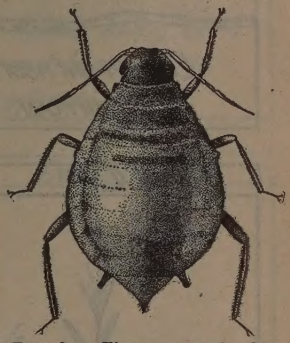

FIG. 3.—The corn root-aphis: Egg-laying female. Greatly enlarged. (Redrawn from Forbes.)

The seasonal history of this insect, which is graphically shown in figure 4, is as follows: The eggs, which are kept by the ants in their nests over winter, begin to hatch about the time smartweed seeds begin to germinate—usually the latter part of March or the first of April—and the young, frail aphids are transferred by the attentive ants to the roots of convenient weeds along which tunnels previously have been made. The aphis is able to live and reproduce on a large variety of weeds, but is most frequently to be found on such common field weeds as smartweed or knotweed,[1] crab grass,[2] purslane,[3] and foxtail or pigeon grass.[4] The young that hatch from eggs mature in about 15 days or longer and give birth to a second generation. Members of this and the succeeding generations until fall give birth to living young, which they produce without fertilization by a male. On an average about 16 or 17 generations occur from the date of hatching in the spring until fall, and the length of each generation varies according to the season, being longer in the spring and fall

[1] *Polygonum* sp.
[2] *Digitaria sanguinalis.*
[3] *Portulaca oleracea.*
[4] *Setaria* sp.

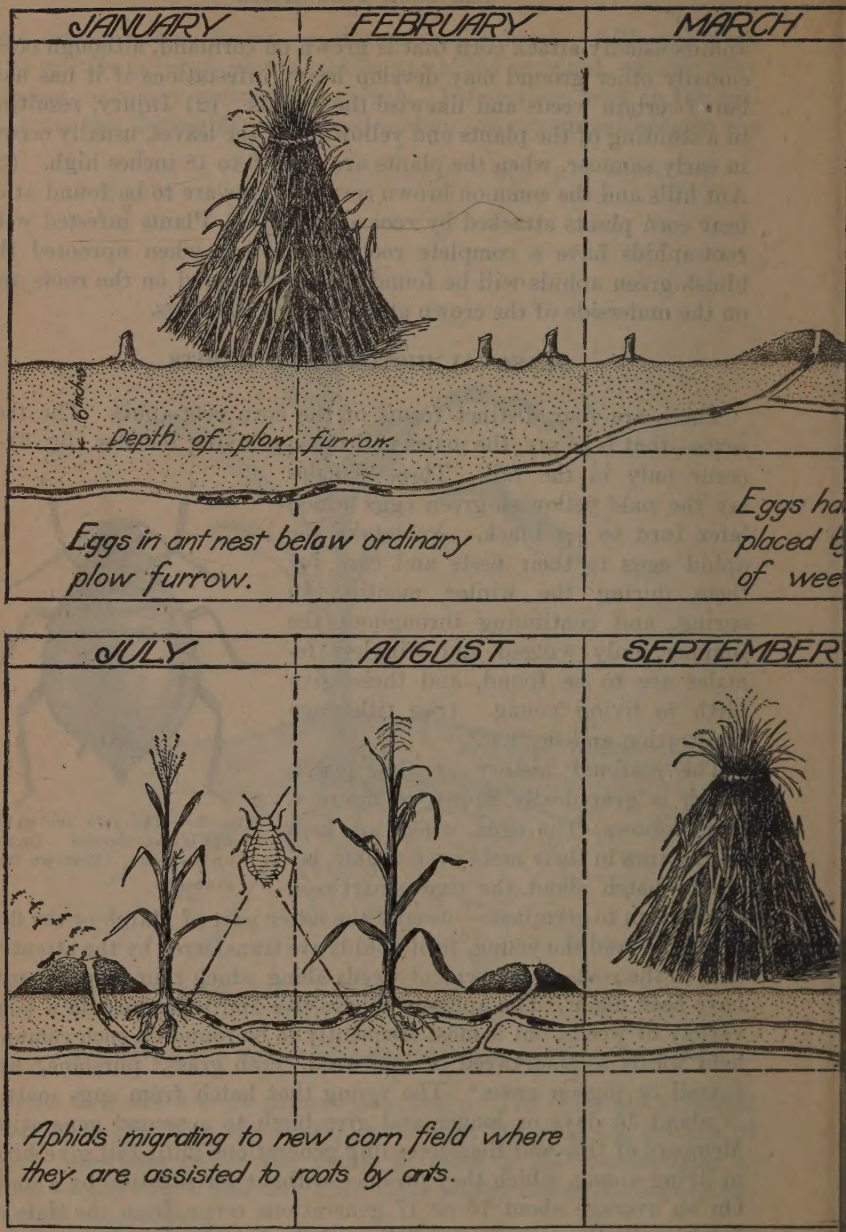

FIG. 4.—Diagram showing history of the corn root-aphids and its relattions with the cornfield an
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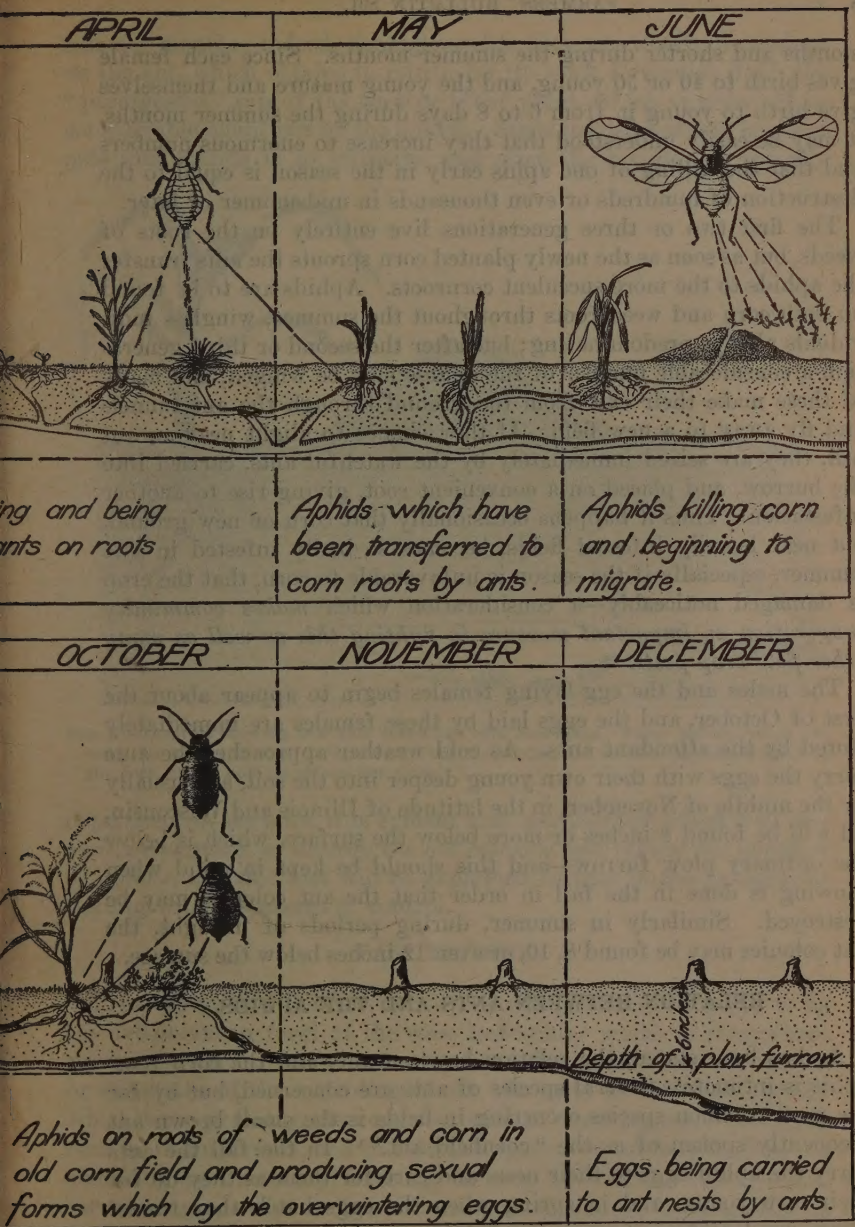
APRIL
MAY
JUNE
ing and being
nts on roots
Aphids which have been transferred to corn roots by ants.
Aphids killing corn and beginning to migrate.
OCTOBER
NOVEMBER
DECEMBER
Depth of plow furrow
Aphids on roots of weeds and corn in old corn field and producing sexual forms which lay the overwintering eggs.
Eggs being carried to ant nests by ants.

ote that during the winter the aphids are carried by the ants below the frost line, where the plow each them.

months and shorter during the summer months. Since each female gives birth to 40 or 50 young, and the young mature and themselves give birth to young in from 6 to 8 days during the summer months, it may be easily understood that they increase to enormous numbers and that the killing of one aphis early in the season is equal to the destruction of hundreds or even thousands in midsummer or later.

The first two or three generations live entirely on the roots of weeds, but as soon as the newly planted corn sprouts the ants transfer the aphids to the more succulent cornroots. Aphids are to be found on both corn and weed roots throughout the summer, wingless individuals always predominating; but after the second or third generation a considerable number of the aphids may be winged, and many of these make their exit from the ground through the ant tunnels and fly away to a new field. If they chance to alight near an ant hill, they are seized immediately by the watchful ants, carried into the burrow, and placed on a convenient root, giving rise to another infestation. Thus it happens occasionally that corn on new ground, but near heavily infested fields, becomes so badly infested in late summer, especially if the season is unfavorable to corn, that the crop is damaged noticeably—a consideration which *makes community cooperation an important measure in fighting this as well as many other field-crop pests.*

The males and the egg-laying females begin to appear about the first of October, and the eggs laid by these females are immediately stored by the attendant ants. As cold weather approaches the ants carry the eggs with their own young deeper into the soil, and usually by the middle of November, in the latitude of Illinois and Wisconsin, all will be found 8 inches or more below the surface, which is below the ordinary plow furrow—and this should be kept in mind when plowing is done in the fall in order that the ant colonies may be destroyed. Similarly in summer, during periods of drought, the ant colonies may be found 8, 10, or even 12 inches below the surface.

RELATION BETWEEN ANTS AND THE APHIDS.

As has been stated, the relation between ants and the corn root-aphis is intimate. Several species of ants are concerned, but by far the most common species occurring in fields is the small brown ant frequently spoken of as the "cornfield ant."[1] In the fall the ants carry the aphid eggs to their nests and care for them as they do for their own young, and in spring when the eggs hatch they tunnel along weed roots and place the helpless aphids on the host plant. (Fig. 5.) The aphids are cared for in the same way during the

[1] *Lasius niger* L., var. *americanus* Emery.

summer months; indeed, throughout life they are wholly dependent on the ant, which obtains in return for its work a sweetish fluid, the "predigested" sap of the corn or other plant, which is given off in considerable quantities by the aphids. Since the relationship between ants and aphids is so intimate, and since the aphids are entirely

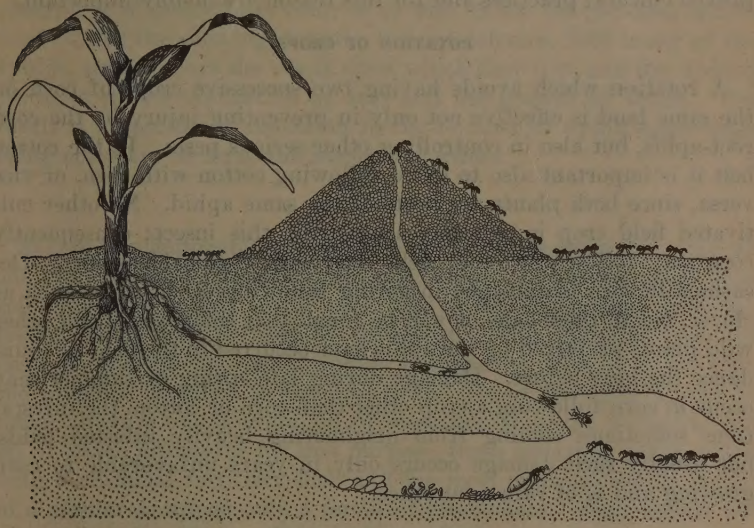

FIG. 5.—Diagram showing how ants foster the corn root-aphis. These aphids, which are cared for by the ants in their nests during the winter, are carried through tunnels to the corn plants and placed on the roots.

dependent on the ants, it is evident that *any method which will disturb, demoralize, or destroy the ant colonies will reduce the numbers of aphids*, and this fact will be explained further in the paragraphs dealing with the means of control.

PAST HISTORY.

Previous to 1891 the corn root-aphis was generally supposed to be the subterranean form of the corn leaf-aphis,[1] which is everywhere present on corn, usually occurring beneath the leaf and ear sheath or the stalks of the unfolding tassel. As early as 1822 root-aphids, which were probably the corn root-aphids, were reported damaging corn in Pennsylvania, and in 1862 this species was definitely observed attacking corn roots and injuring the crop in Illinois. This pest has increased gradually in destructiveness until now it is recognized as one of the four or five most generally injurious insects affecting corn, for it occurs, with few exceptions, wherever this crop is grown in the United States.

[1] *Aphis maidis* Fitch.

METHODS OF CONTROL.

Most of the measures for the prevention or control of the corn root-aphis are methods which not only are effective in reducing or eradicating this and other insect pests, but constitute the more approved cultural practices and for this reason are doubly important.

ROTATION OF CROPS.

A rotation which avoids having two successive crops of corn on the same land is effective not only in preventing injury by the corn root-aphis, but also in controlling other serious pests. In the cotton belt it is important also to avoid following cotton with corn, or vice versa, since both plants are hosts of the same aphid. No other cultivated field crop is seriously affected by this insect; consequently corn may follow any other field crop with reasonable safety. Occasionally corn is damaged in spring following other crops, such as clover, but in these cases it will be found that smartweeds and other wild plants preferred by the aphis have occurred in the field in abundance the year before. Damage during late spring or summer may occur in corn following a crop other than corn or cotton, the infestations sometimes coming from neighboring heavily infested fields, but usually such damage occurs only in years unfavorable to corn growing and is of rare occurrence.

CULTURAL PRACTICES.

The most complete and effective means of controlling the corn root-aphis is thorough stirring of the soil previous to planting. The object of this procedure is to disturb the ant colonies and scatter and kill the aphids so as to permit the plants to make a substantial growth before the ant and aphid colonies can become reestablished, and in addition to prevent the growth of weeds upon which the aphids live, making it necessary for the ants to carry the surviving aphids to new fields. Infested fields which are to be replanted to corn should be plowed to a depth of 6½ or 7 inches in the spring, after March 15 in the latitude of central Indiana and Illinois; then they should have 3 or 4 diskings to a depth of 4 or 5 inches with a 16 or 20 inch disk, the number of cultivations and the intervals between them varying according to the length of the period between plowing and planting. When it is necessary to replant early injured corn the field should first be plowed deeply and thoroughly and then disked deeply 3 or 4 times at intervals of 2 or 3 days. Though these practices necessarily involve additional labor, they not only prevent injury by the corn root-aphis, but also put the field in a much better physical condition. Plowing in the fall before the ant colonies go below the plowline is sometimes as useful as spring plow-

ing, but if warm weather follows the ants may reconstruct their nests so that replowing will be necessary in the spring. In either case the additional spring diskings are essential.

Early fall plowing followed by frequent deep diskings in fields damaged by the root-aphis that season is a good practice from the standpoint of community control, as well as for the personal benefit derived, for the plowing disturbs the ant colonies, kills many of the aphids, and destroys the weeds upon which they live, and the disking prevents the recolonization of ants and the growth of weeds. The result is a significant reduction in the number of aphid eggs—eggs being necessary to carry the insect over winter.

REPELLENTS.

Where it is impossible to practice one of the foregoing measures, an odorous substance offensive to the ants, which will prevent them from colonizing the aphids on the cornroots or will drive them from the treated field, may be used to advantage. This material does not destroy either the ants or the aphids, but tends to drive away the ants, the presence of which is essential to the life of the aphids. Oil of tansy, tincture of asafetida, oil of sassafras, anise oil, kerosene, and oil of lemon are useful for this purpose, these materials being mixed with a chemical fertilizer such as bone meal and applied by means of a planter equipped with a fertilizer attachment. They should not be applied directly on the seed, as such treatment may injure it, especially if the season be wet. Dilute one-fourth pound of oil of tansy with 2 quarts of alcohol and 1 quart of water, or 2 pints of asafetida with 1½ gallons of water, and add either of these substances, thus diluted, to 100 pounds of bone meal, this amount being sufficient for an acre.

MAINTENANCE OF SOIL FERTILITY.

The maintenance of soil fertility by the use of barnyard manure or a commercial fertilizer has been recommended frequently, but is of value only in assisting the plants to outgrow injury either by the corn root-aphis or by any other insect which gradually affects the plant. It does not limit the number of aphids or ants, directly or indirectly, and can scarcely be included properly as a remedial or preventive measure, for if the proper soil fertility were maintained by cultivation and crop rotation excessive artificial fertilization would seldom be necessary.

COOPERATION AS AN IMPORTANT CONTROL MEASURE.

One of the greatest difficulties in the control of insects injurious to field crops is lack of community cooperation, and injury by the corn root-aphis frequently may be traced directly to this cause. The

individual farmer may protect his crop from early injury by the corn root-aphis by cultivation or rotation, *but if neighboring heavily infested fields are left untreated* and the insect is permitted to live and multiply undisturbed *the migrating winged aphids may infest fields previously free from them.* This is especially likely to be the case in years when the spring weather is of such a character that it permits the root aphis to multiply but serves to delay corn planting. It is therefore important that every farmer rotate his crops and cultivate his old cornfields so as to destroy the root-aphis and the attendant ant colonies, whether he plans to replant them to corn or not. If this be done by entire communities, this pest will soon be classed among the corn insects of minor importance or among those known to be only occasionally injurious.

PUBLICATIONS OF UNITED STATES DEPARTMENT OF AGRICULTURE RELATING TO INSECTS INJURIOUS TO CEREAL AND FORAGE CROPS, AVAILABLE FOR FREE DISTRIBUTION BY THE DEPARTMENT.

Common White Grubs. (Farmers' Bulletin 543.)
Larger Corn Stalk-borer. (Farmers' Bulletin 634.)
Chalcis-fly Alfalfa Seed. (Farmers' Bulletin 636.)
Grasshopper Problem and Alfalfa Culture. (Farmers' Buletin 637.)
Hessian Fly. (Farmers' Bulletin 640.)
Alfalfa Attacked by Clover-root Curculio. (Farmers' Bulletin 649.)
Chinch Bug. (Farmers' Bulletin 657.)
Wireworms Destructive to Cereal and Forage Crops. (Farmers' Bulletin 725.)
True Army Worm and its Control. (Farmers' Bulletin 731.)
Corn and Cotton Wireworm in its Relation to Cereal and Forage Crops, with Control Measures. (Farmers' Bulletin 733.)
Clover Leafhopper and its Control in entral States. (Farmers 'Bulletin 737.)
Cutworms and their Control in Corn and other Cereal Crops. (Farmers' Bulletin 739.)
Alfalfa Weevil and Methods of ontrolling It. (Farmers 'Bulletin 741.)
Grasshopper Control in Relation to Cereal and Forage Crops. (Farmers' Bulletin 747.)
Fall Army Worm, or "Grass Worm," and its Control. (Farmers' Bulletin 752.)
How to Detect Outbreaks of Insects and Save the Grain Crops. (Farmers' Bulletin 835.)
Bollworm or Corn Earworm. (Farmers' Bulletin 872.)
Rough-headed Corn Stalk-beetle in Southern States and its Control. (Farmers' Bulletin 875.)
Corn Root-aphids and Methods of Controlling It. (Farmers' Bulletin 891.)
Western Corn Rootworm. (Department Bulletin 8.)
Oat Aphis. (Department Bulletin 112.)
Alfalfa Caterpillar. (Department Bulletin 124.)
Wireworms Attacking Cereal and Forage Crops. (Department Bulletin 156.)
Sharp-headed Grain Leafhopper. (Department Bulletin 254.)
Desert Corn Flea-beetle. (Department Bulletin 436.)
New Mexico Range Caterpillar and its Control. (Department Bulletin 443.)
Two Destructive Texas Ants. (Entomology Circular 148.)

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